

CLAIMS

Having thus described our invention, what we claim as new and desire to secure by Letter of Patent is:

1. A vertically stacked coplanar transmission line structure for an integrated circuit (IC) chip defining a closed ground return path within the transmission line structure, comprising:

a micro-strip pair of first and second vertically stacked coplanar conductors, each comprising a metal layer, a next metal layer down, and an intermediate connecting via layer in between the metal layer and the next metal layer down.
2. The transmission line structure of claim 1, wherein each vertically stacked coplanar conductor comprises metal in the metal layer $m(i)$, metal in the next metal layer down $m(i-1)$, and metal in the intermediate connecting via layer.
3. The transmission line structure of claim 1, fabricated in upper metal layers of the IC chip.
4. The transmission line structure of claim 1, wherein the intermediate connecting via layer comprises a single via bar which extends across an entire width of the intermediate connecting via layer.
5. The transmission line structure of claim 1, wherein the intermediate connecting via layer comprises a plurality of long parallel via bars spaced apart across a width of the intermediate connecting via layer.
6. The transmission line structure of claim 5, wherein the plurality of long parallel via bars are positioned to be close to an inside edge of the coplanar vertically stacked conductor which faces the other coplanar vertically stacked conductor in the transmission line structure.
7. The transmission line structure of claim 1, wherein the micro-strip pair of first and second vertically stacked coplanar conductors comprise a differential positive and negative pair of transmission line conductors.

8. The transmission line structure of claim 1, wherein the micro-strip pair of first and second vertically stacked coplanar conductors comprise signal and ground transmission line conductors.
9. The transmission line structure of claim 1, further comprising a third vertically stacked coplanar conductor comprising a metal layer, a next metal layer down, and an intermediate connecting via layer in between the metal layer and the next metal layer down, and the first, second and third vertically stacked coplanar conductors comprise respectively ground, signal and ground conductors of a waveguide transmission line structure.
10. The transmission line structure of claim 1, further comprising third and fourth vertically stacked coplanar conductors, each comprising a metal layer, a next metal layer down, and an intermediate connecting via layer in between the metal layer and the next metal layer down, and the first, second, third and fourth vertically stacked coplanar conductors comprise respectively a ground, a differential positive and negative pair of transmission line conductors and a ground of a waveguide transmission line structure.
11. A vertically stacked coplanar transmission line structure for an integrated circuit (IC) chip defining a closed ground return path within the transmission line structure, comprising:
a micro-strip pair of first and second vertically stacked coplanar conductors, each comprising a metal layer, a next metal layer down, a second next metal layer down, a first intermediate connecting via layer in between the metal layer and the next metal layer down, and a second intermediate connecting via layer in between the next metal layer and the second next metal layer down.
12. The transmission line structure of claim 11, wherein each vertically stacked coplanar conductor comprises metal in the metal layer $m(i)$, metal in the next metal layer down $m(i-1)$, metal in the second next metal layer down $m(i-2)$, metal in the first intermediate connecting via layer, and metal in the second intermediate connecting via layer

13. The transmission line structure of claim 11, fabricated in upper metal layers of the IC chip.
14. The transmission line structure of claim 11, wherein the first intermediate connecting via layer and the second intermediate connecting via layer each comprises a single via bar which extends across an entire width of the intermediate connecting via layer.
15. The transmission line structure of claim 11, wherein the first intermediate connecting via layer and the second intermediate connecting via layer each comprises a plurality of long parallel via bars spaced apart across a width of the intermediate connecting via layer.
16. The transmission line structure of claim 15, wherein the plurality of long parallel via bars are positioned to be close to an inside edge of the coplanar vertically stacked conductor which faces the other coplanar vertically stacked conductor in the transmission line structure.
17. The transmission line structure of claim 11, wherein the micro-strip pair of first and second vertically stacked coplanar conductors comprise a differential positive and negative pair of transmission line conductors.
18. The transmission line structure of claim 11, wherein the micro-strip pair of first and second vertically stacked coplanar conductors comprise signal and ground transmission line conductors.
19. The transmission line structure of claim 11, further comprising a third vertically stacked coplanar conductor comprising a metal layer, a next metal layer down, a second next metal layer down, a first intermediate connecting via layer in between the metal layer and the next metal layer down, and a second intermediate connecting via layer in between the next metal layer and the second next metal layer down, and the first, second and third vertically stacked coplanar conductors comprise respectively ground, signal and ground conductors of a waveguide transmission line structure.

20. The transmission line structure of claim 11, further comprising third and fourth vertically stacked coplanar conductors, each comprising a metal layer, a next metal layer down, a second next metal layer down, a first intermediate connecting via layer in between the metal layer and the next metal layer down, and a second intermediate connecting via layer in between the next metal layer and the second next metal layer down, and the first, second, third and fourth vertically stacked coplanar conductors comprise respectively a ground, a differential positive and negative pair of transmission line conductors and a ground of a waveguide transmission line structure.